ENGINEERING ANALYSIS

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Boilers
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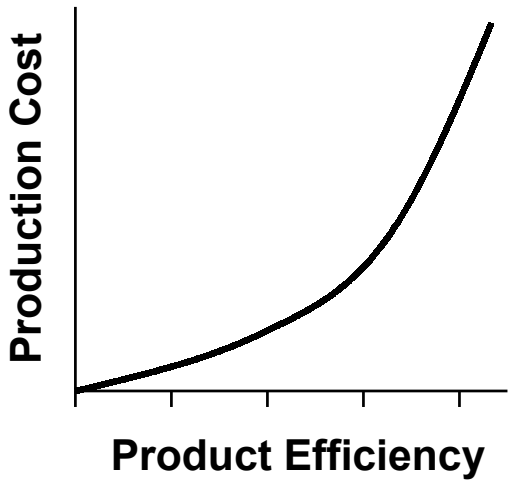
Engineering Analysis Overview

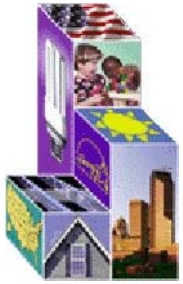
The Engineering Analysis defines the relationship between equipment cost and equipment efficiency for use in downstream analyses.

Equipment Cost - Efficiency Relationship



Downstream Analyses

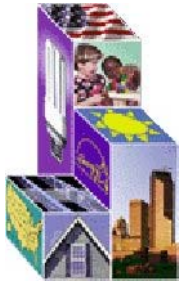
- Consumer Life-Cycle Cost
- Manufacturer Impact
- Employment Impact



Engineering Analysis Characteristics

DOE desires that the cost/efficiency relationships used in the analysis possess certain characteristics.

- Credible
  - based on acceptable estimation techniques
  - incorporates and reconciles available data from multiple sources
- Transparent
  - publicly accessible
  - protects proprietary information
- Specific
  - sufficient detail to reduce ambiguity or misinterpretation
  - a single set of cost-efficiency estimates
  - quantified uncertainties
- Timely
  - available prior to scheduled deadlines

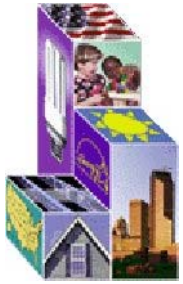


Engineering Analysis
Sources of Efficiency Data

There are several potential sources of efficiency/performance information, when applied to residential furnaces and boilers.

	Primary advantage	. . . disadvantage	
Manufacturers and Suppliers	Direct source of performance data	Detailed data is often the most sensitive	✓
Testing/Rating	Objective and accessible	Products are concentrated near only a few efficiency levels	
Technical Literature	Freely available	Inconsisent topical coverage	✓
Engineering Estimates	Efficient	Scope depends on personnel availability	✓
Simulation Modeling	Flexible	Limited software availability	✓
Prototyping	Direct observation	Resource intensive	✓

✓ ***Can provide direct insight into performance of future equipment under more stringent standards***

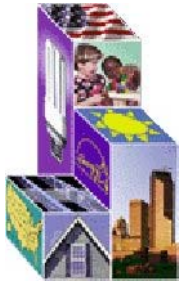


Engineering Analysis
Sources of Manufacturing Cost Data

Similarly, there are several potential sources of manufacturing cost data each with advantages and disadvantages.

	Primary advantage	. . . disadvantage	
Manufacturers and Suppliers	Direct source of cost and market info	Detailed data is often sensitive	✓
Teardown Analysis/ Engineering Evaluation	Direct product observation	Products concentrated near only a few efficiency levels	✓
List Prices	Readily accessible wholesale prices	Indicates overall value, not efficiency-related cost	
Public Data (e.g. Census)	Freely available	Highly aggregated	

✓ ***Can provide direct insight into future costs under more stringent standards***

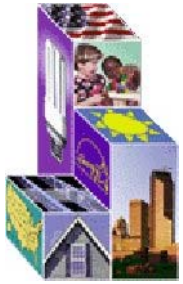


Engineering Analysis
Proposed Approach

Based on the Department's past experience using approaches such as the Design Option and Efficiency Level approach, we propose to combine data sources for this rulemaking.

- Gather publicly available information
- Select representative sample of products for analysis
- Work with manufacturers to identify appropriate samples for teardown and to obtain design data for additional samples
- Conduct computer simulations and engineering estimates to supplement the teardown analysis
- Obtain reviews by stakeholders
- Reconcile results and characterize uncertainty

Based on their advantages and disadvantages, are all these steps necessary, or are others warranted?



Engineering Analysis
Questions Related to Proposed Approach

Depending on which approach we take, there are some questions to be answered.

- What role should manufacturers and other stakeholders have in providing data and reviewing assumptions, methods and results?
- How many teardowns should be conducted? Of which models?
- What simulation models or engineering estimates should be used?
  - FURNACE
  - condensing furnaces (e.g., CONDHX)
  - boilers
- If we draw on multiple sources of information, what guidelines should we use for reconciling them and integrating them into a single set of cost-efficiency data?